Section 5 focuses on changes to No Action and the four action alternatives discussed in the PFR: In-Valley, Ocean, Delta-Chipps Island, and Delta-Carquinez Strait Disposal Alternatives. It summarizes the three new action alternatives (with additional land retirement) from Section 3.

5.1 ALTERNATIVE 1. NO ACTION ALTERNATIVE

The No Action Alternative defines conditions in the project area through the 50-year planning time frame if drainage service is not provided to the San Luis Unit and related areas. It represents existing conditions for drainage management in 2001 with limited changes in management reasonably expected to occur by individual farmers and districts in the absence of Federal drainage service. These changes would be "the future without the project." No Action includes only regional treatment, conveyance, and disposal facilities that existed in 2001 or are authorized, funded projects.

Without Federal drainage service, farmers and districts would not be able to discharge drainwater to receiving waters (sloughs, rivers, bays, or ocean) from drainage-impaired lands except where such discharges are currently permitted (e.g., the Grassland Bypass Project). This restriction means that 379,000 acres projected to need drainage service would not have that service available, and farmers would pursue individual actions related to (1) drainage control and reuse and (2) cropping practices. Water districts and landowners would continue to address drainage problems within institutional, regulatory, and financial constraints currently in effect and reasonably foreseeable.

Land retirement has changed for the No Action Alternative since the 2002 PFR. Land retirement in the PFR included 78,406 acres of retired land. The No Action Alternative retired lands included in the 2002 PFR were:

- 7,000 acres of CVPIA land retirement (permanent)
- 3,006 acres from the Britz Settlement (*Sumner Peck Ranch, Inc., et al. vs. Bureau of Reclamation et al*.)
- 68,400 acres from the Westlands Settlement Agreement (*Sagouspe vs.Westlands Water District*), which could go back into production with the provision of drainage service

An additional 34,100 acres were retired permanently as a result of the Sumner Peck Ranch Settlement of December 2002 and are now included under the No Action Alternative. The 68,400-acre estimate under the Sagouspe settlement was revised to 65,000 acres based on input from Westlands. In summary, 44,106 acres of permanent retirement would be increased by 65,000 acres (Sagouspe settlement) if drainage service is not provided to Westlands, for a total of 109,106 acres.

5.2 COMMON ELEMENTS TO ALL ACTION ALTERNATIVES

5.2.1 Irrigation System Improvements to Reduce Deep Percolation

Irrigation system changes can reduce the production of subsurface drainage (i.e., reduce drainage rates) by reducing the amount of deep percolation reaching the shallow groundwater in the drainage-impaired area. Updated estimates show that it is cost effective to maintain deep

percolation rates at 0.32 foot/year or less in the Westlands drainage-impaired area, and to reduce deep percolation rates by 0.1 foot/year or more in the Westlands upslope areas and in the Northerly Area. The assumption that on-farm irrigation system improvements would be made to enhance irrigation efficiencies was developed for the In-Valley Alternatives analysis. It will be carried forward into the analysis of the Out-of-Valley Alternatives in the Draft EIS. See Section 3.3.10.3.

Any irrigation system improvement demonstrated to contribute to these deep percolation targets could be supported. Systems could include, but are not limited to, surface and subsurface drip irrigation, carefully managed surface irrigation systems such as surge-control furrow systems or level-basin systems, and other pressurized irrigation systems such as low-energy precision application (LEPA) and linear-move sprinklers. All systems require a high level of irrigation management expertise to achieve high levels of application efficiency.

5.2.2 Drainwater Collection System (In-Valley)

The original closed collection system described in the PFR was expanded to address a known Se-related issue in the Firebaugh area in the vicinity of the unlined Delta-Mendota Canal. The issue involves shallow high-Se groundwater getting into the unlined canal through adjacent underlying drains and sumps that discharge into the canal. The canal itself would not become part of the collection system; rather, the proposed collection system for irrigation drainage service would intercept this groundwater at the existing sumps before it has a chance to enter the canal and convey it to the Northerly Reuse Area for reuse, treatment, and disposal.

5.2.3 Reuse Areas

The PFR described the four generalized reuse areas (Northerly Area, Westlands North, Westlands Central, and Westlands South) where the drainwater would be used to irrigate salt-tolerant crops. Each reuse facility would also serve as an underground regulating reservoir to control the flow of reused drainwater to downstream features. At the reuse facilities, subsurface tile drains would be installed to collect the reused drainwater. The reused drainwater would be conveyed via pipeline to treatment and/or disposal facilities.

Currently, up to 16 **regional reuse facilities** are proposed within the four generalized areas. Drainage quantity and lands required for reuse vary with the alternative. Between 7,500 and 19,000 acres are needed to accommodate the drainage volume of 26,830 to 69,645 AF/year. The final reuse sites are still being refined based upon the service area providing drainwater to each reuse site, field verification and investigation, and review by affected parties.

Several criteria were used for these potential site locations. Each site is located to take advantage of gravity flows to convey drainwater to the reuse area, without using unduly large pipe sizes. Each site location attempts to make use of some existing land that has been retired. Soil types were important criteria, primarily to avoid heavy clay contents and the low hydraulic conductivity boundary. All sites have been sized to include source control reductions.

The four generalized reuse areas are described as follows:

- Northerly Reuse Area – the proposed area is an extension of Grassland Bypass Project's existing drainwater reuse site and lies contiguous to that site. The proposed expansion area is

as much as 4,300 acres in size. Total acres needed for drainwater reuse are 8,200 acres to serve 81,000 acres (of which 54,000 acres would have tile drains).

- Westlands North Reuse Area – seven potential reuse sites, encompassing about 3,000 acres, have been selected in the northern part of Westlands to accommodate the drainwater reuse acreage needed to serve 67,800 acres.
- Westlands Central Reuse Area – five areas, encompassing 5,138 acres, in Westlands have been identified to accommodate the reuse acreage needed to serve 120,462 acres. Existing retired lands are limited in this area, so some additional land purchase will be required.
- Westlands South Reuse Area – three areas, encompassing 2,631 acres, in Westlands have been identified to accommodate the reuse acreage needed to serve 57,769 acres. The reuse locations are along the district's eastern boundary. These locations make the best use of gravity flow to the reuse areas and also use the existing Westlands retired lands as much as possible. Furthermore, the area was selected to avoid interference with Lemoore Naval Air Station.

Further detail on the reuse area sizing (and discharge) is included in Appendix C.

5.2.4 Mitigation Measures

All action alternatives would include design features, operating procedures, and other pre- and post-construction measures to minimize or avoid potential impacts to significant biological resources, including protected species, important habitats, and natural communities. Depending on the features/components of the action alternatives, a range of mitigation measures and strategies from the following categories would be selected:

- Incorporation of design and siting measures
- Completion of pre-construction biological surveys and wetland delineations
- Use of approved construction measures and practices
- Adoption of O&M measures that minimize impacts
- Implementation of facility monitoring and adaptive O&M plans

5.3 ALTERNATIVE 2. OCEAN DISPOSAL ALTERNATIVE

The Ocean Disposal Alternative would include the common elements of all alternatives: on-farm and in-district actions, drainwater collection systems, and regional reuse facilities. Reused drainwater would be collected from the reuse facilities and transported by pipelines and tunnels to the Pacific Ocean for disposal. The pipeline conveyance system, would lie within the San Joaquin Valley from near Los Banos southeast to just south of Kettleman City, and then extend southwesterly to the Pacific Ocean at Point Estero. The ocean diffuser would be approximately 1.5 miles offshore, at a depth of 200 feet, approximately 10 miles south of the southern boundary of Monterey Bay National Marine Sanctuary.

The only difference planned for the Ocean Disposal Alternative is that the aqueduct would collect drainwater from 16 locations near the existing San Luis Drain instead of four, because 16 reuse facilities are now proposed in the four generalized reuse areas.

The Federal project costs for the Ocean Disposal Alternative are currently in the process of being updated and will be presented in the Draft EIS.

5.4 ALTERNATIVE 3. DELTA DISPOSAL ALTERNATIVES

The Delta Disposal Alternatives (Delta-Chipps Island and Delta-Carquinez Strait) would include the common elements of all alternatives: on-farm and in-district actions, drainwater collection systems, and regional reuse facilities. In addition, the reuse area discharge would also be treated with biological Se treatment. Drainwater from the four drainage areas (Northerly, Westlands North, Westlands Central, and Westlands South) would be conveyed to a central treatment facility before conveyance by canal and pipeline to the Delta for disposal. RO treatment is not included in the Delta Disposal Alternatives. The canal and pipeline conveyance system would extend the existing San Luis Drain from its current terminus at Mud Slough to the north-northwest through Merced, Stanislaus, San Joaquin and Contra Costa counties for disposal at the western end of the Delta at either Chipps Island or 16 miles further downstream near Carquinez Strait.

The Federal project costs for the two Delta Disposal Alternatives are currently in the process of being updated and will be presented in the Draft EIS.

The Se biotreatment process for the two Delta Disposal Alternatives has changed considerably from the PFR and is described below.

5.4.1 New Selenium Treatment

The Se biotreatment facility described in the PFR consisted of a gravity-fed system with a series of five anoxic lagoon cells, an aerated lagoon, a filtration system, and feed tanks and pumps. The lagoons were covered with a floating cover, and the carbon source for the Se biotreatment was methanol.

In 2003, Reclamation became aware of a new biotreatment technology that was patented and commercialized by Applied Biosciences, Inc., Salt Lake City, Utah. Applied Biosciences has developed and optimized technologies to remove Se and nitrate from various waters through lab developed biological cultures and bioreactor vessels.

For the new Se treatment, there would be four Se biotreatment plants, based on the Applied Biosciences technology, one for each of the drainage areas (Northerly, Westlands North, Westlands Central, and Westlands South). The Applied Biosciences technology can reduce the Se concentration in the effluent to 10 µg/L or less, based on recent pilot studies. Additional testing of the pilot system is underway. The effluent from the biotreatment plants would be discharged to evaporation basins for the In-Valley Disposal Alternatives or to the Delta for the Delta Disposal Alternatives.

A schematic of a typical 1,000 AF/year biotreatment module is shown on Figure 5-1. The facility is constructed for gravity flow through the treatment facility. The facility consists of a modular bioreactor system and accompanying nutrient distribution and flushing system. Each module is composed of two trains of three bioreactor cells per train with a capacity of 1,000 AF/year per module. The residence time in a bioreactor train is approximately 6 hours. The bioreactor cells are filled with carbon media that provide a surface area to develop a biological film that reduces the dissolved Se to a solid form that is captured within the biomass. One bioreactor cell is

roughly 23 feet in height, length, and width; thus, one module is 69 feet in length and 46 feet in width.

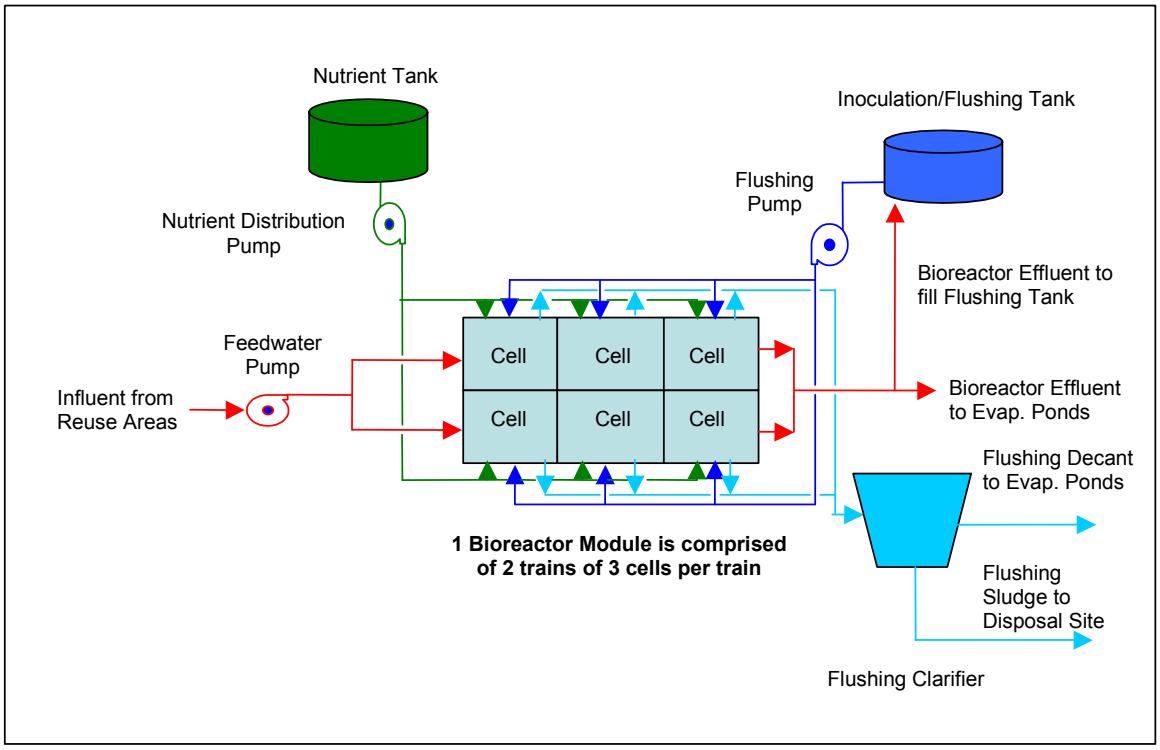

Figure 5-1 Process Flow Schematic for Typical Bioreactor Module

A full description of the biotreatment plant will be provided in the Draft EIS. The primary components of the biotreatment plant consist of a plant feedwater pump, bioreactor cells, nutrient storage tank, nutrient pump, inoculation/flushing storage tank, and flushing pump.

5.5 ALTERNATIVE 4. IN-VALLEY DISPOSAL ALTERNATIVE

The In-Valley Disposal Alternative would lie within the San Joaquin Valley and entirely within the boundaries of the drainage study area. This alternative would include the common elements of all alternatives: on-farm and in-district actions, drainwater collection systems, and regional reuse facilities. In addition, reuse facility drainwater would be treated with RO and biological Se treatment before disposal in evaporation basins. Table 5-1 shows the revised assumptions and specifications including land requirements for this alternative.

Table 5-1
Revised In-Valley Disposal Alternative Specifications

	Westlands	Northerly Area	Total
Area of Projected Increased Irrigation Efficiency[a]	253,000	126,000	379,000
Identified drainage-impaired area (acres)[b]	298,000	81,000	379,000
New recycling area (acres)[c]	246,030	-	246,030
Shallow groundwater management area (acres)[d]	39,755	600	40,355
Seepage reduction area (acres)[e]	-	36,000	36,000
Retired lands (acres)[f]	44,106	-	44,106
Additional retired lands[g]	-	-	-
Total reuse and evaporation basin area required (acres)[h]	12,700	9,590	22,290
Existing facility area (acres)[i]	-	4,303	4,303
New facilities area within existing retired lands (acres)[j]	4,836	-	4,836
New facilities area in Westlands/private lands (acres)[k]	7,864	5,287	13,151
Total drainage collection area (acres)[l]	246,030	81,000	327,030
New collector area (acres)[m]	246,030	6,000	252,030
Collection area with on-farm tiles (percent)[n]	67	67	-
Existing tiled area (acres)[o]	5,000	48,000	53,000
New tiled area (acres)[p]	159,020	6,000	165,020
Drainage rate (AF/acre)[q]	0.35	0.42	-
Drainage produced before shallow groundwater management[r]	57,407	38,080	95,487
Drainage reduction from shallow groundwater management[s]	4,921	810	5,731
Drainage reduction from seepage reduction[t]	-	4,200	4,200
Drainage collected (AF)[u]	52,486	33,070	85,556
Drainage recycled (AF)[v]	12,302	4,700	17,002
Net drainage delivered to reuse areas (AF)[w]	40,185	29,460	69,645
Reuse area application rate (AF/acre)[x]	4.17	4.00	-
Total reuse area required (acres)[y]	10,800	8,200	19,000
Existing reuse area (acres)[z]	-	4,303	4,303
New reuse area required (acres)[aa]	10,800	3,897	14,697
Drainage rate from reuse area (AF/acre)[bb]	1.13	1.08	-
Volume from reuse to RO facilities (AF)[cc]	12,260	8,856	21,116
Reuse volume treated with RO (percent)[dd]	100	100	-
Volume from RO to Se treatment facilities (AF)[ee]	6,130	4,428	10,558
Volume from Se treatment to evaporation basins (AF)[ff]	6,130	4,428	10,558
Evaporation rate for sizing evaporation basins (AF/acre)	4.00	4.00	-
Depth of storage facility for evaporation basins (feet)	4.00	4.00	-
Evaporation rate for evaporation basin O&M costs (AF/acre)[gg]	4.75	4.75	-
Total evaporation basin area required (acres)[hh]	1,900	1,390	3,290
Existing evaporation basin area (acres)	-	-	-
New evaporation basin area required (acres)[ii]	1,900	1,390	3,290
Evaporation basin area for O&M costs (acres)[jj]	1,660	1,210	2,870
Evaporation basin mitigation required (acres)[kk]	2,080	1,520	3,600

Table 5-1
Revised In-Valley Disposal Alternative Specifications

[a] Westlands upslope lands=551,000–298,000 acres; Northerly Area=85,600 San Luis Unit acres + 40,400 non-San Luis Unit acres.
[b] Defined in Source Control Memo and 2002 PFR (Westlands=298,000 acres, Northerly Area=45,000 San Luis Unit acres+36,000 non-San Luis Unit acres).
[c] Source Control Memo, scaled for new tiled lands.
[d] Source Control Memo, scaled for new tiled lands.
[e] Control Memo.
[f] Westlands retired lands (Summer-Peck, Britz, CVPIA). Northerly Area retired lands (Broadview).
[g] Calculated.
[h] Calculated: Total Required Reuse + Evaporation Basin Area.
[i] Calculated: Existing Reuse + Existing Evaporation Basin.
[j] Facilities located within Sumner-Peck and Britz lands: Reuse=3,636 acres; evaporation basins=1,200 acres.
[k] Calculated: Total Reuse/Evaporation Area - Existing Reuse/Evaporation Area.
[l] Solved for 88,576 total Westlands acres retired, including existing retired lands and required reuse/evaporation facilities.
[m] Westlands is set equal to total collection area. Northerly Area is input from Source Control Memo.
[n] Groundwater model result.
[o] Source Control Memo (reduced by 6,500 tiled acres retired in Broadview).
[p] Westlands is calculated. Northerly Area is input from Source Control Memo. (6,000 acres are located in Northerly Area drainage-impaired area).
[q] Groundwater estimate (0.16) plus add back the .05 deep percolation reduction, times the groundwater model adjustment factor of 1.5.
[r] Calculated based on uncontrolled flow (15,400) minus seepage reduction (4,200) (from Source Control Memo).
[s] Use rate per collected acre of 0.02 (Westlands) and 0.01 (Northerly Area) from Source Control Memo.
[t] Source Control Memo.
[u] Calculated.
[v] Westlands = .05 AF/acre within the new recycling area. Northerly Area = 4,700 AF plus .05 AF/acre within the new recycling area.
[w] Calculated. Northerly Area includes 1,077 additional AF.
[x] Westlands from field modeling-estimated drainflows (weighted). Northerly Area from Source Control Memo.
[y] Calculated. Includes Safety Factor (divided by 0.9).
[z] SJRIP.
[aa] Calculated.
[bb] Source Control Memo (27 percent of Reuse Application Rate).
[cc] Calculated.
[dd] Assumption: All reuse drainage will be treated with RO.
[ee] Calculated.
[ff] Calculated.
[gg] Average annual evaporation rate; used for O&M cost estimates.
[hh] Calculated for peak flows: Includes additional storage area required for 3 months. Rounded up to next 100.
[ii] Calculated.
[jj] Calculated: Evaporation basin area calculated based on average annual evaporation rate used for O&M cost estimate.
[kk] Calculated: Preliminary assumption of 1.25 acres of mitigation for each acre of evaporation basin based on average annual evaporation rate. Estimate to be revised in the EIS based on results of ecological risk assessment.

5.5.1 Reverse Osmosis Treatment

Reused drainwater from all areas would be treated by RO to produce high quality product water that could be blended with CVP water for use in irrigation. In the PFR, data indicated that RO treatment would be cost effective only in the Northerly Area. Subsequent pilot testing and data collection indicate that RO treatment of drainwater in Westlands is effective as well, and RO treatment plants would be located near each evaporation basin. Each RO system would consist of a single-stage, single-pass array with appropriate pretreatment to achieve 50 percent recovery.

Filtration of reused drainwater would be the same as described in the PFR with the exception that an injection of a biocide may be required to prevent biological growth in the membrane

elements. The size of the RO facility would still occupy about 6 acres. It is assumed that the product water would be conveyed to and blended with CVP water in a nearby canal. The concentrate reject stream would be conveyed to a biotreatment facility for Se removal and later to an evaporation facility for disposal.

5.5.2 Selenium Biotreatment

Discharge (reused drainwater) from the reuse facilities would be treated for Se removal to reduce the Se-related impacts associated with evaporation basin disposal. In addition, the concentrate reject stream from the RO facilities would also be conveyed to the Se treatment facilities. In total, there would be four Se biotreatment plants, one for each of the drainage areas (Northerly, Westlands North, Westlands Central, and Westlands South). These facilities are described above under the Delta Disposal Alternatives.

5.5.3 Evaporation Basins

Treated water from the Se biotreatment plant (at a maximum Se concentration of 10 μg/L) is then conveyed to evaporation basins for disposal. The PFR described two regional evaporation basins with a total planned acreage of approximately 5,000 acres. Periodic excavation and on-site burial of accumulated salts was likely to be required after 80 to 100 years of operation, and additional cells would have been constructed to replace cells used for the salt burial, if needed.

Several changes have been made to the evaporation basin designs since the PFR, including:

- Wells would be established in proximity to each basin site to verify and monitor groundwater conditions before, during, and after evaporation basin installation.
- Basins would be located on existing retired lands where practical.
- Most basins would be surrounded by reuse areas, which would act as a buffer zone for adjacent land use to reduce impacts.
- Evaporation basins would consist of sequential evaporation cells that diminish in size as the drainage flows towards the terminal cell where final salt precipitation occurs.
- Basin operational design would include provisions to evacuate individual evaporation basin cells if inflow is not sufficient to maintain a 4-foot minimum depth.

About 16 square miles of land are under investigation for four sites for evaporation facilities. At present, it is estimated that approximately 3,290 acres would be needed in total for the four facilities: 1,390 in Northerly Area; 1,900 in Westlands North, Central, and South.

This acreage is based on the flow being provided by the reuse areas. The final evaporation basin sites would be fine-tuned based upon the flow from the reuse areas and the amount of water treatment provided to the influent. Selection for the generalized locations of the proposed evaporation basins was based on the following characteristics:

- Soil type
- Groundwater quality
- Land use

- Endangered/protected species and habitats
- Flood risk
- Seismic risk
- Proximity to proposed reuse areas served

5.5.4 Evaporation Basin Mitigation

The PFR described specific mitigation that would be required to reduce and/or compensate for impacts to waterfowl and shorebirds exposed to elevated Se at the In-Valley Alternative's proposed evaporation basins. Preliminary concept designs called for development of 3,200 to 6,400 acres of habitat to be developed at two large mitigation areas. Mitigation acreages at the time were based on application of U.S. Fish and Wildlife Service mitigation protocols for determining alternative and compensation habitat obligations.

Currently, evaporation basin mitigation for the In-Valley Disposal Alternative (and In-Valley/Land Retirement Alternatives) are being reexamined. The size, number, and locations of proposed evaporation basins have changed substantially and previous estimates of anticipated influent Se concentrations are no longer valid.

An evaporation basin mitigation strategy will be developed for the EIS following completion of an ecological risk assessment, an evaporation basin bioaccumulation pilot study, and the subsequent reevaluation of the applicability of the current U.S. Fish and Wildlife Service protocols.

5.6 ALTERNATIVE 5. IN-VALLEY/GROUNDWATER QUALITY LAND RETIREMENT ALTERNATIVE

This alternative consists of retiring all the lands in Westlands with Se concentration greater than 50 ppb in the shallow groundwater and lands acquired by Westlands (38,000 acres that could be brought into production with drainage service). It would also retire 10,000 acres in Broadview Water District in the Northerly Area. Total land retirement is 92,592 acres. Lands remaining in production within the drainage-impaired area would be eligible for drainage service. The collection, treatment, and disposal of drainwater collected from drained lands would be similar to that described in the 2002 PFR and updated in Section 5.5 for the In-Valley Disposal Alternative, but at a smaller scale. Table 5-2 shows the revised assumptions for the In-Valley/Groundwater Quality Land Retirement Alternative specifications for the entire project area including lands outside the Unit in the Northerly Area. Drainage volumes delivered to reuse areas are estimated at 61,036 AF/year, with 9,229 AF/year discharged to evaporation basins following reuse, RO, and Se treatment.

Table 5-2
In-Valley/Groundwater Quality Land Retirement Alternative Specifications

	Westlands	Northerly Area	Total
Area of Projected Increased Irrigation Efficiency[a]	253,000	126,000	379,000
Identified drainage-impaired area (acres)[b]	298,000	81,000	379,000
New recycling area (acres)[c]	209,424	-	209,424
Shallow groundwater management area (acres)[d]	33,654	600	34,254
Seepage reduction area (acres)[e]	-	36,000	36,000
Retired lands (acres)[f]	44,106	10,000	54,106
Additional retired lands[g]	38,486	-	38,486
Total reuse and evaporation pond area required (acres)[h]	10,820	8,770	19,590
Existing facility area (acres)[i]	-	4,303	4,303
New facilities area within existing retired lands (acres)[j]	4,836	-	4,836
New facilities area in Westlands/private lands (acres)[k]	5,984	4,467	10,451
Total drainage collection area (acres)[l]	209,424	71,000	280,424
New collector area (acres)[m]	209,424	6,000	215,424
Collection area with on-farm tiles (percent)[n]	67	67	-
Existing tiled area (acres)[o]	5,000	41,500	46,500
New tiled area (acres)[p]	134,616	6,000	140,616
Drainage rate (AF/acre)[q]	0.35	0.42	-
Drainage produced before shallow groundwater management[r]	48,866	35,350	84,216
Drainage reduction from shallow groundwater management[s]	4,188	710	4,898
Drainage reduction from seepage reduction[t]	-	4,200	4,200
Drainage collected (AF)[u]	44,677	30,440	75,117
Drainage recycled (AF)[v]	10,471	4,700	15,171
Net drainage delivered to reuse areas (AF)[w]	34,206	26,830	61,036
Reuse area application rate (AF/acre)[x]	4.17	4.00	-
Total reuse area required (acres)[y]	9,200	7,500	16,700
Existing reuse area (acres)[z]	-	4,303	4,303
New reuse area required (acres)[aa]	9,200	3,197	12,397
Drainage rate from reuse area (AF/acre)[bb]	1.13	1.08	-
Volume from reuse to RO facilities (AF)[cc]	10,358	8,100	18,458
Reuse volume treated with RO (percent)[dd]	100	100	-
Volume from RO to Se treatment facilities (AF)[ee]	5,179	4,050	9,229
Volume from Se treatment to evaporation ponds (AF)[ff]	5,179	4.050	9,229
Evaporation rate for sizing evaporation ponds (AF/acre)	4.00	4.00	-
Depth of storage facility for evaporation ponds (feet)	4.00	4.00	-
Evaporation rate for evaporation pond O&M costs (AF/acre)[gg]	4.75	4.75	-
Total evaporation pond area required (acres)[hh]	1,620	1,270	2,890
Existing evaporation pond area (acres)	-	-	-
New evaporation pond area required (acres)[ii]	1,620	1,270	2,890
Evaporation pond area for O&M costs (acres)[jj]	1,420	1,110	2,530
Evaporation pond mitigation required (acres)[kk]	1,780	1,390	3,170

Table 5-2 (concluded)
In-Valley/Groundwater Quality Land Retirement Alternative Specifications

[a] Westlands upslope lands=551,000–298,000 acres; Northerly Area=85,600 San Luis Unit acres + 40,400 non-San Luis Unit acres.
[b] Defined in Source Control Memo and 2002 PFR (Westlands=298,000 acres, Northerly Area=45,000 San Luis Unit acres+36,000 non-San Luis Unit acres).
[c] Source Control Memo, scaled for new tiled lands.
[d] Source Control Memo, scaled for new tiled lands.
[e] Control Memo.
[f] Westlands retired lands (Summer-Peck, Britz, CVPIA). Northerly Area retired lands (Broadview).
[g] Calculated.
[h] Calculated: Total Required Reuse + Evaporation Pond Area.
[i] Calculated: Existing Reuse + Existing Evaporation Pond.
[j] Facilities located within Sumner-Peck and Britz lands (Terry Cooke/Roger Burnett): Reuse=3,636 acres; evaporation ponds=1,200 acres.
[k] Calculated: Total Reuse/Evaporation Area - Existing Reuse/Evaporation Area.
[l] Solved for 88,576 total Westlands acres retired, including existing retired lands and required reuse/evaporation facilities.
[m] Westlands is set equal to total collection area. Northerly Area is input from Source Control Memo.
[n] Groundwater model result.
[o] Source Control Memo (reduced by 6,500 tiled acres retired in Broadview).
[p] Westlands is calculated. Northerly Area is input from Source Control Memo. (6,000 acres are located in Northerly Area drainage-impaired area).
[q] Groundwater estimate (0.16) plus add back the .05 deep percolation reduction, times the groundwater model adjustment factor of 1.5.
[r] Calculated based on uncontrolled flow (15,400) minus seepage reduction (4,200) (from Source Control Memo).
[s] Use rate per collected acre of 0.02 (Westlands) and 0.01 (Northerly Area) from Source Control Memo.
[t] Source Control Memo.
[u] Calculated.
[v] Westlands = .05 AF/acre within the new recycling area. Northerly Area = 4,700 AF plus .05 AF/acre within the new recycling area.
[w] Calculated. Northerly Area includes 1,077 additional AF.
[x] Westlands from Roger Burnett-estimated drainflows (weighted). Northerly Area from Source Control Memo.
[y] Calculated. Includes Safety Factor (divided by 0.9).
[z] SJRIP.
[aa] Calculated.
[bb] Source Control Memo (27 percent of Reuse Application Rate).
[cc] Calculated.
[dd] Assumption: All reuse drainage will be treated with RO.
[ee] Calculated.
[ff] Calculated.
[gg] Average annual evaporation rate; used for O&M cost estimates.
[hh] Calculated for peak flows: Includes additional storage area required for 3 months. Rounded up to next 100.
[ii] Calculated.
[jj] Calculated: Evaporation pond area calculated based on average annual evaporation rate used for O&M cost estimate.
[kk] Calculated: Preliminary assumption of 1.25 acres of mitigation for each acre of evaporation pond based on average annual evaporation rate. Estimate to be revised in the EIS based on results of ecological risk assessment.

5.7 ALTERNATIVE 6. IN-VALLEY/WATER NEEDS LAND RETIREMENT ALTERNATIVE

This alternative would retire enough lands to balance the internal water use needs of the San Luis Unit or 193,956 acres. This value would include lands with Se concentrations greater than 20 ppb in Westlands, lands already acquired by Westlands, and 10,000 acres in Broadview Water District. Lands remaining in production within the drainage-impaired area would be provided for drainage service. The collection, treatment, and disposal of drainwater collected from drained lands would be similar to that described in the 2002 PFR and updated in Section 5.5 for the In-Valley Disposal Alternative, but at a smaller scale. Table 5-3 shows the revised assumptions for the In-Valley/Water Needs Land Retirement Alternative specifications. Drainage volumes delivered to reuse areas are estimated at 45,287 AF/year, with 6,865 AF/year discharged to evaporation basins after reuse, RO, and Se treatment.

Table 5-3
In-Valley/Water Needs Land Retirement Alternative Specifications

	Westlands	Northerly Area	Total
Area of Projected Increased Irrigation Efficiency[a]	253,000	126,000	379,000
Identified drainage-impaired area (acres)[b]	298,000	81,000	379,000
New recycling area (acres)[c]	113,000	-	113,000
Shallow groundwater management area (acres)[d]	17,583	600	18,183
Seepage reduction area (acres)[e]	-	36,000	36,000
Retired lands (acres)[f]	44,106	10,000	54,106
Additional retired lands[g]	139,850	-	139,850
Total reuse and evaporation pond area required (acres)[h]	5,880	8,770	14,650
Existing facility area (acres)[i]	-	4,303	4,303
New facilities area within existing retired lands (acres)[j]	4,836	-	4,836
New facilities area in Westlands/private lands (acres)[k]	1,044	4,467	5,511
Total drainage collection area (acres)[l]	113,000	71,000	184,000
New collector area (acres)[m]	113,000	6,000	119,000
Collection area with on-farm tiles (percent)[n]	67	67	-
Existing tiled area (acres)[o]	5,000	41,500	46,500
New tiled area (acres)[p]	70,333	6,000	76,333
Drainage rate (AF/acre)[q]	0.35	0.42	-
Drainage produced before shallow groundwater management[r]	26,367	35,350	61,717
Drainage reduction from shallow groundwater management[s]	2,260	710	2,970
Drainage reduction from seepage reduction[t]	-	4,200	4,200
Drainage collected (AF)[u]	24,107	30,440	54,547
Drainage recycled (AF)[v]	5,650	4,700	10,350
Net drainage delivered to reuse areas (AF)[w]	18,457	26,830	45,287
Reuse area application rate (AF/acre)[x]	4.17	4.00	-
Total reuse area required (acres)[y]	5,000	7,500	12,500
Existing reuse area (acres)[z]	-	4,303	4,303
New reuse area required (acres)[aa]	5,000	3,197	8,197
Drainage rate from reuse area (AF/acre)[bb]	1.13	1.08	-
Volume from reuse to RO facilities (AF)[cc]	5,630	8,100	13,730
Reuse volume treated with RO (percent)[dd]	100	100	-

Table 5-3 (concluded)
In-Valley/Water Needs Land Retirement Alternative Specifications

	Westlands	Northerly Area	Total
Volume from RO to Se treatment facilities (AF)[ee]	2,815	4,050	6,865
Volume from Se treatment to evaporation ponds (AF)[ff]	2,815	4,050	6,865
Evaporation rate for sizing evaporation ponds (AF/acre)	4.00	4.00	-
Depth of storage facility for evaporation ponds (feet)	4.00	4.00	-
Evaporation rate for evaporation pond O&M costs (AF/acre)[gg]	4.75	4.75	-
Total evaporation pond area required (acres)[hh]	880	1,270	2,150
Existing evaporation pond area (acres)	-	-	-
New evaporation pond area required (acres)[ii]	880	1,270	2,150
Evaporation pond area for O&M costs (acres)[jj]	770	1,110	1,880
Evaporation pond mitigation required (acres)[kk]	970	1,390	2,360

[a] Westlands upslope lands=551,000–298,000 acres; Northerly Area=85,600 San Luis Unit acres + 40,400 non-San Luis Unit acres.
[b] Defined in Source Control Memo and 2002 PFR (Westlands=298,000 acres, Northerly Area=45,000 San Luis Unit acres+36,000 non-San Luis Unit acres).
[c] Source Control Memo, scaled for new tiled lands.
[d] Source Control Memo, scaled for new tiled lands.
[e] Control Memo.
[f] Westlands retired lands (Summer-Peck, Britz, CVPIA). Northerly Area retired lands (Broadview).
[g] Calculated.
[h] Calculated: Total Required Reuse + Evaporation Pond Area.
[i] Calculated: Existing Reuse + Existing Evaporation Pond.
[j] Facilities located within Sumner-Peck and Britz lands (Terry Cooke/Roger Burnett): Reuse=3,636 acres; evaporation ponds=1,200 acres.
[k] Calculated: Total Reuse/Evaporation Area - Existing Reuse/Evaporation Area.
[l] Solved for 88,576 total Westlands acres retired, including existing retired lands and required reuse/evaporation facilities.
[m] Westlands is set equal to total collection area. Northerly Area is input from Source Control Memo.
[n] Groundwater model result.
[o] Source Control Memo (reduced by 6,500 tiled acres retired in Broadview).
[p] Westlands is calculated. Northerly Area is input from Source Control Memo. (6,000 acres are located in Northerly Area drainage-impaired area).
[q] Groundwater estimate (0.16) plus add back the .05 deep percolation reduction, times the groundwater model adjustment factor of 1.5.
[r] Calculated based on uncontrolled flow (15,400) minus seepage reduction (4,200) (from Source Control Memo).
[s] Use rate per collected acre of 0.02 (Westlands) and 0.01 (Northerly Area) from Source Control Memo.
[t] Source Control Memo.
[u] Calculated.
[v] Westlands = .05 AF/acre within the new recycling area. Northerly Area = 4,700 AF plus .05 AF/acre within the new recycling area.
[w] Calculated. Northerly Area includes 1,077 additional AF.
[x] Westlands from Roger Burnett-estimated drainflows (weighted). Northerly Area from Source Control Memo.
[y] Calculated. Includes Safety Factor (divided by 0.9).
[z] SJRIP.
[aa] Calculated.
[bb] Source Control Memo (27 percent of Reuse Application Rate).
[cc] Calculated.
[dd] Assumption: All reuse drainage will be treated with RO.
[ee] Calculated.
[ff] Calculated.
[gg] Average annual evaporation rate; used for O&M cost estimates.
[hh] Calculated for peak flows: Includes additional storage area required for 3 months. Rounded up to next 100.
[ii] Calculated.
[jj] Calculated: Evaporation pond area calculated based on average annual evaporation rate used for O&M cost estimate.
[kk] Calculated: Preliminary assumption of 1.25 acres of mitigation for each acre of evaporation pond based on average annual evaporation rate. Estimate to be revised in the EIS based on results of ecological risk assessment.

5.8 ALTERNATIVE 7. IN-VALLEY/DRAINAGE-IMPAIRED AREA LAND RETIREMENT ALTERNATIVE

This alternative would retire 308,000 acres, including all the drainage-impaired lands in Westlands – approximately 298,000 acres. The Northerly Area (non-Westlands) is excluded from land retirement except for 10,000 acres in Broadview Water District (for reasons identified in Section 3.3.10.2). Drainage collection, treatment, and disposal facilities would be avoided in the Westlands drainage-impaired areas. The collection, treatment, and disposal of drainwater collected from the Northerly Area would be similar to that described in the 2002 PFR and updated in Section 5.5 for the In-Valley Disposal Alternative. Water made available from this alternative would exceed the agricultural water demand by the remaining lands within the Unit, and would be available for reallocation or sale for other purposes within the CVP service area. Table 5-4 shows the revised assumptions for the In-Valley/Drainage-Impaired Area Land Retirement Alternative specifications. Drainage volumes delivered to the Northerly Area reuse areas are estimated at 26,830 AF/year, with 4,050 AF/year discharged to evaporation basins after reuse, RO, and Se treatment.

Table 5-4
In-Valley/Drainage-Impaired Area Land Retirement Alternative Specifications

	Westlands	Northerly Area	Total
Area of Projected Increased Irrigation Efficiency[a]	253,000	126,000	379,000
Identified drainage-impaired area (acres)[b]	298,000	81,000	379,000
New recycling area (acres)[c]	-	-	-
Shallow groundwater management areas (acres)[d]	-	600	600
Seepage reduction areas (acres)[e]	-	36,000	36,000
Retired lands (acres)[f]	44,106	10,000	54,106
Additional retired lands[g]	253,894	-	253,894
Total reuse and evaporation pond area required (acres)[h]	-	8,770	8,770
Existing facility area (acres)[i]	-	4,303	4,303
New facilities area within existing retired lands (acres)[j]	-	-	-
New facilities area in Westlands/private lands (acres)[k]	-	4,467	4,467
Total drainage collection area (acres)[l]	-	71,000	71,000
New collector area (acres)[m]	-	6,000	6,000
Collection area with on-farm tiles (percent)[n]	67	67	-
Existing tiled area (acres)[o]	-	41,500	41,500
New tiled area (acres)[p]	-	6,000	6,000
Drainage rate (AF/acre)[q]	0.35	0.42	-
Drainage produced before shallow groundwater management[r]	-	35,350	35,350
Drainage reduction from shallow groundwater management[s]	-	710	710
Drainage reduction from seepage reduction[t]	-	4,200	4,200
Drainage collected (AF)[u]	-	30,440	30,440
Drainage recycled (AF)[v]	-	4,700	4,700
Net drainage delivered to reuse areas (AF)[w]	-	26,830	26,830
Reuse area application rate (AF/acre)[x]	4.17	4.00	-
Total reuse area required (acres)[y]	-	7,500	7,500
Existing reuse area (acres)[z]	-	4,303	4,303
New reuse area required (acres)[aa]	-	3,197	3,197
Drainage rate from reuse area (AF/acre)[bb]	1.13	1.08	-
Volume from reuse to RO facilities (AF)[cc]	-	8,100	8,100
Reuse volume treated with RO (percent)[dd]	100	100	-

Table 5-4 (concluded)
In-Valley/Drainage-Impaired Area Land Retirement Alternative Specifications

	Westlands	Northerly Area	Total
Volume from RO to Se treatment facilities (AF)[ee]	-	4,050	4,050
Volume from Se treatment to evaporation ponds (AF)[ff]	-	4,050	4,050
Evaporation rate for sizing evaporation ponds (AF/acre)	4.00	4.00	-
Depth of storage facility for evaporation ponds (feet)	4.00	4.00	-
Evaporation rate for evaporation pond O&M costs (AF/acre)[gg]	4.75	4.75	-
Total evaporation pond area required (acres)[hh]	-	1,270	1,270
Existing evaporation pond area (acres)	-	-	-
New evaporation pond area required (acres)[ii]	-	1,270	1,270
Evaporation pond area for O&M costs (acres)[jj]	-	1,110	1,110
Evaporation pond mitigation required (acres)[kk]	-	1,390	1,390

[a] Westlands upslope lands=551,000–298,000 acres; Northerly Area=85,600 San Luis Unit acres + 40,400 non-San Luis Unit acres.
[b] Defined in Source Control Memo and 2002 PFR (Westlands=298,000 acres, Northerly Area=45,000 San Luis Unit acres+36,000 non-San Luis Unit acres).
[c] Source Control Memo, scaled for new tiled lands.
[d] Source Control Memo, scaled for new tiled lands.
[e] Control Memo.
[f] Westlands retired lands (Summer-Peck, Britz, CVPIA). Northerly Area retired lands (Broadview).
[g] Calculated.
[h] Calculated: Total Required Reuse + Evaporation Pond Area.
[i] Calculated: Existing Reuse + Existing Evaporation Pond.
[j] Facilities located within Sumner-Peck and Britz lands (Terry Cooke/Roger Burnett): Reuse=3,636 acres; evaporation ponds=1,200 acres.
[k] Calculated: Total Reuse/Evaporation Area - Existing Reuse/Evaporation Area.
[l] Solved for 88,576 total Westlands acres retired, including existing retired lands and required reuse/evaporation facilities.
[m] Westlands is set equal to total collection area. Northerly Area is input from Source Control Memo.
[n] Groundwater model result.
[o] Source Control Memo (reduced by 6,500 tiled acres retired in Broadview).
[p] Westlands is calculated. Northerly Area is input from Source Control Memo. (6,000 acres are located in Northerly Area drainage-impaired area).
[q] Groundwater estimate (0.16) plus add back the .05 deep percolation reduction, times the groundwater model adjustment factor of 1.5.
[r] Calculated based on uncontrolled flow (15,400) minus seepage reduction (4,200) (from Source Control Memo).
[s] Use rate per collected acre of 0.02 (Westlands) and 0.01 (Northerly Area) from Source Control Memo.
[t] Source Control Memo.
[u] Calculated.
[v] Westlands = .05 AF/acre within the new recycling area. Northerly Area = 4,700 AF plus .05 AF/acre within the new recycling area.
[w] Calculated. Northerly Area includes 1,077 additional AF.
[x] Westlands from Roger Burnett-estimated drainflows (weighted). Northerly Area from Source Control Memo.
[y] Calculated. Includes Safety Factor (divided by 0.9).
[z] SJRIP.
[aa] Calculated.
[bb] Source Control Memo (27 percent of Reuse Application Rate).
[cc] Calculated.
[dd] Assumption: All reuse drainage will be treated with RO.
[ee] Calculated.
[ff] Calculated.
[gg] Average annual evaporation rate; used for O&M cost estimates.
[hh] Calculated for peak flows: Includes additional storage area required for 3 months. Rounded up to next 100.
[ii] Calculated.
[jj] Calculated: Evaporation pond area calculated based on average annual evaporation rate used for O&M cost estimate.
[kk] Calculated: Preliminary assumption of 1.25 acres of mitigation for each acre of evaporation pond based on average annual evaporation rate. Estimate to be revised in the EIS based on results of ecological risk assessment.